



# Gas flow optimization - Experience and benefits of gas flow optimization methods in NAFTA a.s.

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# AGENDA

In 2017 after more than 2 years of development Optimization Software ("OS") was put into operation in NAFTA. Aim of this presentation is to share with audience:

- Experience from development of Optimization Software
- Fuel gas saving achieved
- What-if analysis supported by Optimization Software



## **UGS NAFTA Introduction**



Working gas volume (WGV)	30.5 TWh
Max. withdrawal rate (WR)	392 GWh/d
Max. injection rate (IR)	338 GWh/d

\* source: <u>www.nafta.sk</u>, data as of 9 April 2018



# **Description of Optimization Software**

Functions of Optimization Software:



If gathered input data are altered, we can perform what-if analysis

The general idea of the Optimization Software can be described in two steps:

- a) Transform gas storage into graph using graph theory.
- b) Use standard methods of mathematical programming to solve the problem and find optimum solution (mainly using methods of mixed integer linear programming).



#### UGS NAFTA Infrastructure – real life lessons





graph with more than 250 nodes and 400 edges

Task is too complex to be optimized at once. Hence, several iterative runs are used for each optimization, where each subsequent iteration increases detail of the calculation and if possible decreases number of nodes and edges.



#### Fuel gas saving achieved during injection season 2017





### Fuel gas saving – Standard vs. Complex scenarios





#### What-if analysis – case study 1 – cost of compressor unavailability





#### What-if analysis – case study 1 – cost of compressor unavailability





#### What-if analysis – case study 2 – cost of additional withdrawal rates



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#### What-if analysis – case study 3 – cost of pressure loss



FUELING THE FUTURE

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# Conclusion

NAFTA's experience with development and operation of Optimization Software:

- Optimization model can be quite complex iterative approach seems to be appropriate solution
- Optimization Software can deliver valuable fuel gas saving (more than 4% in our case)
- Complex scenarios (with many compressors running) are more suitable to be optimized
- Optimization Software can be used also for what-if analysis